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THE ENGINEER AND CIVILIZATION[1]

IF we may accept the estimates of archeologists, it is now some hundred thousand years or more since man began to manifest, in some marked degree, those characteristics which have served as the foundation upon which the superstructure called civilization has been erected.

Throughout this long evolution, three great principles or lines of action have stood out as the determining factors. These are specialization, cooperation and the utilization of the resources of nature. These are, in fact, all interrelated. No one is independent of the other two.

So long as the unit of life is the individual, or at most the family, there can be but small progress toward a state of what we term "civilization." So long as a man or a family must do all the things necessary for his or its life, no one thing can be done with super-skill or super-excellence, and progress must needs be slow. The acquirement of super-skill or of super-excellence means specialization, concentration and the limitation of activity to a relatively narrow line of endeavor. Only by this pathway can progress be made. But if the individual is to limit his own activity to a narrow line of endeavor and give to this field of work his entire time and effort, he will obviously be in no position to provide for himself, at first hand, more than some of the things needful for life, and he must perforce depend on others for those things which he can not supply himself. This means that he must contribute from the results of his own skill to the needs of his neighbors and that he must count on receiving from them, in return, the products of their special skill to supplement his own lack. Thus is born the principle of cooperative effort, and out of this flows, of necessity, the commercial institution of barter and exchange.

THE BEGINNINGS OF MATERIAL CIVILIZATION

If we seek to place a finger upon the very beginnings of what we may term "material civilization," we shall find it at that point where some race or community of men of primordial stamp and character began to realize and enjoy the advantages accruing through the utilization of some combination product of human skill directed upon a raw material of the earth. For, with the growth of such a condition, there would come

[1] Presidential address at the annual meeting, New York, November 30 to December 4, 1925, of the American Society of Mechanical Engineers.

a premium on human skill, and thence an inducement for specialization and concentration on some particular line of human endeavor. And with this must come the whole train of specialized human effort, cooperation and mutual dependence as foundation blocks for the building up of a civilization.

Again, if we seek to place a finger upon the time, place and circumstance when, where and how such a condition first came into evidence as a guiding factor in human evolution, we shall apparently find at least one such point in central and southern Europe during the old stone age, and in connection with the utilization of flint arrow and spear heads for the chase, and of other crude stone implements for the simple and homely arts of that far-away time. Man had placed his foot on one of the first rungs of the ladder of progress toward civilization when he found a way of adapting the crude stone fragments lying about him to the needs of life. Definite and material advantages accrued as a result of the use of such implements fashioned from these resources of nature—certainly among the first of such resources to be utilized for other than direct food purposes.

To take, for a moment, a more narrow view in point of time, consider the culmination of this age in the so-called Solutrian phase of culture, and located, in time, perhaps twenty-five thousand years ago.

In that age there might have been seen, about the wonderful limestone caves of southern France, communities of the people of the age, living in or about the cave and practicing the arts of the time. The food supply came primarily from the chase and the flint arrow head and spear head played here a most important part. In this age the art of fashioning flint arrow and spear heads seems to have reached its culmination. In no age before or since have there been produced their equals in beauty and perfection of form, proportion and finish.

Now there seems to be good evidence that the peculiar skill which was required to shape these beautiful examples of chipped-stone art was by no means the common property of all the men of a community. Rather was it, presumably, the property of a limited few, or perhaps of one, who would thus, by force of circumstance, become the arrow- and spear-head maker for the community. Here then perhaps may we discern the very *first* example, in the development of our civilization, of a clearly defined specialization or differentiation of function in a community of human beings. And with such specialization there must come cooperative relations, barter and exchange, and thus the foundation for a modern state of society.

Is it too forced a use of language to call this ancient arrow-head maker an industrialist, perhaps an inventor, and an engineer?

It is of the essence of the work of the industrialist that he shall organize, plan and carry forward undertakings calculated to provide, often in quantity and through repetition processes, the material things of which civilization has need.

It is of the essence of the work of the inventor that he is able to recognize some need in the arts of civilization and to find a way to supply such lack.

It is of the essence of the work of the engineer that he deals in a large way with the constructive materials of the earth and with the energies of nature—all to the end of useful service in the arts of civilization.

The Arrow-Head Maker the Prototype of the Industrialist and Engineer

Surely we can discern in the work of this ancient arrow-head maker and in his relation to the community life of that day the clear beginnings of those functions which, in more recent times, we designate as those of the industrialist, the inventor and the engineer. Indeed, the distinction between these terms is often arbitrary and the same individual may be, and often is, any one, two or all three of these at one and the same time. If, then, we may designate, in a large way, this field as that of the engineer, we may fairly say that far back in those prehistoric times, easily twenty thousand to thirty thousand years before we have even the beginnings of recorded history, we may clearly discern the germ and the essence of the exercise of that function in society which we, as engineers of a later day, consider our own peculiar responsibility.

But the arrow-head maker of the old stone age by no means stands alone as a prototype of the modern engineer. There is his fellow, perhaps of a somewhat later time, who invented the art of weaving, especially as expressed in crude basketry, and thus gave to man, perhaps, his first container or carrier. And again, not long subsequent, that ceramic engineer who discerned, perhaps first through the burning of a clay-lined wickerwork basket, the influence of fire upon clay, and thus laid the foundation of the great modern ceramic industries which have come to mean so much in our own day, and the development of which can be so clearly traced down through the ages. And again, what of that engineer scientist-inventor of twenty thousand years ago, perhaps, who gave to the world of that day the bow and arrow with its wonderfully effective utilization of the laws of mechanics regarding the transformations of energy? We may, in fact, see in play here the entire sequence of invention and engineering science.

Primitive Utilization of Mechanical Laws

All invention must start with the recognition of a

lack or need, and following this there must be some mental vision of a manner in which this lack or need may be supplied. The invention must be subjective before it can become objective. There must be in the mind of the inventor some mental picture of the means whereby the lack may be filled before it can become clothed in material form. And so some one, in some way, in those remote times caught some realization of a need or insufficiency in the weapons used in the chase, and following upon such recognition he must have gained some mental picture of a way in which the need could be met and the insufficiency supplied. And so was produced the combination of bow and arrow, with its wonderfully effective means for receiving the organic energy of the bowman as he pulls the arrow and flexes the bow, and for storing it in potential form, expressed as the potential energy of a distorted elastic system. And then, at the instant of his choice, with the arrow released by the fingers, this stored energy becomes transformed into kinetic energy expressed in the flight of the arrow toward its mark. Truly a wonderful series of energy transformations, and realized with marvelous efficiency and perfect adaptation to purpose!

THE GREAT ANTIQUITY OF THE ENGINEERING PROFESSION

Do we, as engineers of the present day, stop to remember that whenever, in our modern mechanism, we utilize a spring, no matter of what form or character, we are simply following along the path marked out by this great inventor-engineer of the long ago? Do we not, as did he, simply use the distortion of an elastic system and its release as a means for storing and transforming energy? And again, in this same category of scientist-engineer, there is the inventor of the sling. This ancient military engineer or huntsman found a way of utilizing the kinetic energy of a rapidly rotating material system. We do the same with the flywheel and, so far as basic principle is concerned, we are simply again following along the pathway first worked out by this engineer-inventor of a vanished race and of a departed age.

And again, have there not been naval architects and shipbuilders since the days of the long dugout?—a period of not less than fifteen thousand years; have there not been bridge builders since our ancient forebears—no one can guess how many ages ago—first learned to throw a log across a stream, or to stretch, suspension-wise, cables made of twisted vines or other like material?

And have there not been metallurgists and metallurgical engineers since the days of Tubal Cain who, as we are told in Genesis, was "an instructor of every artificer in brass and iron"? And have there not been great structural engineers and builders who for six thousand years past at least have been enriching the earth with the products of their genius and skill—as witness the wonders of Nineveh, Babylon, Egypt, Greece and Rome, or again the records of the Maya and earlier civilizations on our own continent?

And so, as we follow the sequence of the utilization of the constructive materials of Nature and of her energies down through the ages—from the products of early paleolithic or rough chipped-stone culture to later paleolithic, and then to neolithic or polished stone, horn and bone, and then on to bronze and so finally to iron and steel and thence into the more complex conditions of modern times—we see continuously and clearly the accumulating results of specialization, of cooperative human labor and of the inheritance, by each successive generation, of the accumulated culture of those which have preceded it.

If I have taken this length of time to examine the early beginnings of the art and practice of engineering, it has been to draw attention to the great antiquity of our profession and to justify, in some degree, the claim, which we may make, of belonging to the first group or guild of society which became distinguished in relation to the community at large by reason of some peculiar or special function or service rendered.

We sometimes consider that engineering and the engineer, in the distinctively modern sense of the terms, do not antedate the invention of the steam engine and the beginning of the utilization of the inorganic energies of nature—those developments which have so revolutionized the material content of our civilization during the past two hundred years. The distinction, however, is superficial rather than fundamental; the informing spirit and purpose are the same. The difference results primarily from the enormously increased magnitude and diversity of the material content of our present-day civilization, arising from the utilization of the inorganic energies of nature in lieu of the organic energies of man or domestic animals. It has resulted, naturally, that the engineer of to-day must be a man of far different training and type of activity than his brother of three hundred or five hundred or one thousand or ten thousand years ago. But the point which I make is simply that, in spirit, in purpose and in relation to the civilization of the age, the art and practice of the engineer of the present day have their roots far back before the dawn of written history—back in those first movements in human society which gave

evidence of the working of some leaven of evolution, and which in one hundred thousand years or more have led us from the condition of our paleolithic ancestors up and into the condition and circumstance which we now enjoy.

MODERN MATERIAL CIVILIZATION A PRODUCT OF THE ENGINEERING GUILD

And so, in these latter days, we have come into a state of civilization, so-called, of which the objective content, with its richness and complexity, is the product of this guild of those who work with the materials of the earth and with the energies of nature. But so commonplace has all this become that the world accepts us and we accept ourselves as part of the scheme of things with little thought of the extent to which this work of the engineer, in the broadest sense of the term, permeates our entire community life.

Suppose we take so humble an object as the slice of toast which appears on our breakfast table. Do we stop to consider the extent to which engineering and the engineer have entered into the vast cooperative enterprise necessary to the production of so commonplace a result? Thus we find that the soil on which was grown the wheat was turned up by a gang plow drawn by a tractor. The grain was sown, harvested, winnowed and bagged by machinery driven by power. The bags of grain were transported to a rail shipping point by motor truck and thence by rail to a wheat center. The entire program of milling, transport of flour to bakery, mixing, kneading, baking and delivery at the kitchen door is again realized through the use of power and energy. And finally, its preparation on the electric toaster is an expression of the utilization of power in its very latest and most versatile form.

And again, what of the design and construction of all these mechanisms and agencies—the plow, the reaper, the motor truck, the locomotive and the freight car; the rails on which they run, the bridges, trestles and tunnels over and through which they pass; the flouring mill, the bakery equipment, the auto-delivery wagon, and finally, the long line of electric machinery, apparatus and equipment which takes mechanical energy at a far-distant point, transmutes it into the electrical form and brings it over mountain and valley and across plain to our door, and so to the electric toaster on the breakfast table; there again to be transformed into heat and applied to the bread to render it the more toothsome? And as we thus eat our toast while reading the morning paper, what thought do we give to the manifold energy transformations, the hundreds of mechanisms, devices and appliances and the thousands of individuals whose joint labor and service have made this simple act on our part possible?

Or again, consider the newspaper itself. The happenings of the entire world are brought by telegraph, telephone, radio or mail service, assembled within one room, there by typewriter transformed into copy, thence, by the aid of wonderful type forming machines and technical processes, expressed in the form of records on cylindrical metal shells, and thence, through one of the marvels of modern inventions the printing press, transformed into the printed page, moved by auto truck, railway train and otherwise, and finally laid on our doorstep ready for consumption with the toast. All these complex operations and processes, as well as the mechanisms and agencies through which they are realized, are again only an outward expression of a combination of the materials of the earth; the energies of nature and the directive agency of man, and therefore fall within the direct and peculiar field of the engineer.

And as with these familiar examples, so with the entire *material* content of our civilization. The food we eat, the houses in which we dwell, the clothes we wear, the facilities we enjoy by way of travel on land, over water or through the air, of trade and commerce with the farthest ends of the earth, of communication with our fellow by written word, telegraph, telephone or radio, the *material* facilities and means through which we maintain an ordered state of society through government and judicial procedure, the *material* means whereby we transmit the culture of our own age to our children through education, and indeed the *material* background of the organization of our society which makes it possible for select spirits to find time for reflection, for study, for things of the mind and of the spirit rather than things of the body—turn which way we may in the tangled maze of our modern life, and we find on every hand dependence, in some degree at least, on that combination of constructive materials, energies of nature and the directive agency of man which constitutes the especial field of activity and service of the engineer.

This enunciation of the place of the engineer in the progress of civilization is uttered in no boastful spirit and with no purpose of exalting his services over those of his brothers in arms. The carrying on of our present-day civilization calls for the exercise of a vast number of diverse though interdependent functions. There is no need of an attempt at enumeration. All are necessary, and no one is independent of the others. Rather all are dependent on each and each is dependent on all. If the tiller of the soil, the herdsman, the merchant, the banker, the doctor, the lawyer,

are all dependent on the engineer, so is he in turn dependent on them. Life is like some intricately woven web of chain mail wherein each link is necessary to and in turn dependent upon all the others. Truly, the ideal of our civilization is that one shall labor for all and all for one.

And so, in the endeavor to mark out the place of the engineer in our modern civilization the purpose has been not to exalt but rather to bring into emphasis the opportunity for service as the measure of the responsibility which attaches to us, both in our individual and collective capacities.

If we, as a guild, stand as the repository of the results of the work of our fellows in bygone ages, even from prehistoric days down to the present time, and as trustees for its useful application to the requirements of our own times, then must we, as a guild, recognize our responsibilities to worthily carry on with this great accumulation which has been placed in our hands. It is only the simple truth to say that the trend of civilization in coming ages—especially as to its material content—will depend in fundamental degree upon the manner in which we discharge our obligations during the short day in which this responsibility and opportunity are placed in our hands. We pass this way but once; the opportunity will not come again. Future ages and future generations are awaiting the enjoyment of a *material* civilization, the character of which is, in some measure at least, in our hands to determine, here and to-day.

How the Engineer may best serve the Cause of Advancing Civilization

If, now, we turn to more practical aspects of the matter and ask how we may so act as to properly discharge these duties and responsibilities, we come fairly face to face with the simple query: What is the duty of the engineer of to-day, and how may he best serve the cause of advancing civilization?

The discharge of a duty is, in large degree, a personal matter; we can not easily lay down directions for the individual, but, in the aggregate, we can perhaps safely venture to indicate what seems to be the line of obligation.

In the first place, it is perfectly clear that each individual owes it as a duty to himself, to his guild and to the world at large that he cultivate to the highest practicable degree the faculties and gifts of which by heredity and environment he has become the living expression.

This is simply an application of the parable of the talents and there is no reason for argument or discussion. Its application and the resultant obligation upon the individual are self-evident.

But individual bricks do not make a building, nor isolated human units a society. If there is any one lesson to be drawn from a study of the evolution of our civilization, it is that of the significance of cooperation. This is the mortar which serves to bind together the individual units and make of them a coherent, enduring and purposeful structure.

And so, binding together the individual units of our society, there must be the spirit of cooperation; and if this is true for society at large, it is doubly so for those of the guild of the engineer. No one is better qualified to realize the basic law of mechanics that mass effect can be realized only by mass action. The time has gone by when man might be measurably sufficient unto himself. This is the age of great undertakings, and these can be realized only through joint and cooperative effort.

The Part Engineering Societies have played in the Developments signalizing the Last Half-Century

And so, in order to further such ends we as engineers have organized ourselves into groups with closely allied interests and purposes, and have thus formed the great engineering societies of the present day.

If we form, as best we may, in mental vision some composite picture of these great organizations the world over, we shall obtain a most impressive realization of the application of this principle of cooperation and mutual helpfulness. And no one who will study this picture will fail to realize the significant part which these societies have played in the great engineering developments which have signalized the last half-century. It is not perhaps too much to say that the organization of these societies, furnishing as they have great centers around which engineering activities have crystallized, has constituted the most important single element in making possible these latter-day achievements in engineering; and that during this time they have played a vitally essential part in this march along the lines of material progress.

And here again, what has been said with regard to the development of the individual will furnish a sure guide when applied to these great organizations as groups of individuals.

The engineering societies, collectively and individually, will best serve the public welfare and best contribute to the progress of civilization by developing, each in its own sphere, to the highest possible degree. The picture of one great engineering society, embracing all who may call themselves engineers and covering the whole field of engineering activity and service, is indeed a beautiful ideal. It seems hardly practicable, however, having in view the great diversity of interest and character of work, and the limitations of the individual regarding the extent of the field which

he himself can cover. Were indeed any such society organized, it would inevitably divide up into subgroups, divisions, sections, and what not, each one corresponding to some one measurably narrow field of interest and activity, even as we note similar centrifugal tendencies in the older and more widely comprehensive societies of the present day. And so we may conclude that intensive development, each within its own boundaries, and assiduous cultivation, each of its own field of activity, will best contribute to swell the grand total of service which the world expects of these great organizations and which they are under obligation to render.

But the parallel between the individual and the society must not stop here. If cooperation is necessary between and among individuals in order to achieve larger ends, so also is it necessary between and among societies in order that *they* may achieve the larger ends which the progress of civilization demands. There are many problems of wide sweep for the solution of which the world is looking to the engineer—or to the engineer in alliance with his brother the scientist—and which touch simultaneously the fields of activity of several of our modern engineering societies. These can not be adequately and properly studied by any one body or group alone. All the mental acumen which can be brought to bear upon these problems will be none too much to light up the pathway toward some solution. Again the lines of demarcation between the fields of activity of our several societies are often vague, and many fields of activity may fairly enough be claimed by more than one of them. All this is of course well known, and is a natural result of the marvelous growth in the activity of the engineer during the past half century and the vast extension in the scope of his work. This situation, however, should lead only to the exhibition of a spirit of kindly cooperation and friendly emulation, motivated throughout by a readiness to unite whole-heartedly in joint undertakings, whenever or wherever such procedure may indicate a more useful result than through individual society effort.

Some Questions for Engineers in their Individual and Collective Capacities

Let us attempt to gather up in a single sweep of vision some concept of the great guild of the engineer with its historic background, tracing far away to the very first impulses toward civilization and with its unique and important place in the fabric of our present-day life; and with this concept in mental vision, will it be amiss if we ask ourselves a few questions?

Do we, either as individuals or as societies, often enough seek out the mountain tops and endeavor, from such vantage point of view, to place ourselves in relation to the great problems and movements of the day and to properly orient our own purposes and aims in relation thereto?

Are we, both as individuals and as societies, too prone to the microscopic view rather than the telescopic?

Are we so occupied with the immediate task, with that which is set before us as the day's work, that we are in danger of failing to appreciate the articulation of our own task with that of our fellow, or to give thought as to how his task and ours may best fit into the great problems which the progress of our civilization presents?

Have we, either as individuals or as societies, sufficiently well-defined goals or purposes in our professional life? Have we definite aims professionally toward which we are working with a conscious purpose, or are we following too much the opportunist policy of dealing as best we may with individual problems as they arise and of doing the day's work as it comes along?

Again, are we, either as individuals or as societies, sufficiently alive to the opportunity and duty of taking constructive and helpful part in the larger life movements about us? Do we sufficiently realize the obligation which lies upon us of contributing, as opportunity may offer, helpfully to the solution of great problems which may seem to lie aside from the normal field of our professional life?

Do we, in short, sufficiently realize the obligation of good citizenship along and paralled with the day's work in our chosen field of activity?

Are we, in brief, both as individuals and as societies, striving to definitely direct our course over the sea of life with a firm hand at the helm, with definite objectives in view, with a long look ahead, with a generous recognition of our duty to the generations coming after, and with an appreciation of the larger duties of life as members of a great social organism? Or, are we looking only at our immediate environment with its professional problems, and allowing ourselves, with reference to the larger aspects of life, to drift, subject to currents and tides of which we take little or no heed?

These are indeed searching questions. You of the profession are as well able to answer them as am I. But it will perhaps be safe to assume that neither as individuals nor as societies is our score in these respects what it should be.

If then we imagine ourselves upon the mountain top, may we spend a few moments in looking a little more closely at some few of the things which we might thus discern, and, seeing, ask ourselves whether

or not we are living up to the full measure of our obligations thereto.

THE DUTY OF THE ENGINEER AS REGARDS CONSERVATION OF NATURAL RESOURCES

Among the many which might thus challenge our attention, none is perhaps of greater importance than that aspect of the duty of the engineer which centers around the general term "conservation of natural resources."

We have already noted the peculiar position in which the engineer stands relative to the constructive materials of the earth and to the inorganic energies of nature. He is their custodian, and charged with the duty and has assumed the responsibility of their development and use to meet the requirements of human progress.

Now the facts are, as engineers well know, that the supplies under these categories are far from unlimited in extent. We know of this fact of limitation and that in some instances it is defined with relative sharpness. Furthermore, we have no assurance of the operation of natural agencies tending toward replacement, at least in any degree commensurate with the rate at which we are carrying on with their exploitation and exhaustion. Future generations may perhaps grow beyond the need of some of the things which we now find necessary. Substitutes may be found in some cases. But we can not be sure of this and in the absence of such assurance it does devolve upon the engineer as a most weighty obligation that he give heed to the means which he employs in the exploitation of these natural resources, and that every possible effort be made to avoid waste and to use them with the highest attainable degree of economy and efficiency. Avoidable waste is a direct theft from generations to be. With the lack of care which has characterized much of the exploitation of the resources of nature, especially during the last half century, have we not wasted, in some measure, the patrimony of our children and grandchildren? Imagine that in some way the progress of civilization had been hastened and that the exploitation of the resources of nature had begun on a grand scale with the Romans, two thousand years ago; and suppose that they and their descendants had carried on, as have we during the last fifty or one hundred years; in what condition should we be to-day? We are not to infer that the sole responsibility in these matters lies with the engineer—he may fairly share it with society as a whole; but after all, his is perhaps the major share because no one is so well qualified as he to see the consequences of the reckless exploitation of nature, and upon no one does the duty lie so clearly to lift up his voice in protest and to direct his professional energies and skill along lines looking toward the reduction of waste and inefficiency to the lowest minimum.

To this latter duty he has, in fact, responded, and in many cases with most gratifying results. But the end is not yet and only by untiring, wholehearted, continuing effort along such lines can the engineer in anticipation look fearlessly in the eye his brothers of the next generation or the next century, and await their estimate of the manner in which he has discharged the duties of his own day and generation.

Again, if from our fancied mountain top we look in another direction, we shall see ourselves as legatees of a hundred thousand years and more of a gradually growing accumulation. Each age and generation has added some quotum to this vast accumulation of which we are the trustees and executives. Can we either as individuals or societies take a just sense of pride in what we are accomplishing from year to year in this respect? And coming closer home, are we as a society discharging our whole duty in the matter of research and its support? With our numbers and our resources, should we not take a more aggressive stand in this matter and devote, year by year, a larger share of our energies and of our resources to the support of research along lines which lie within the field which we consider peculiarly our own?

THE RENEWAL OF PERSONNEL IN THE ENGINEERING PROFESSION THROUGH TECHNICAL EDUCATION

But let us turn again and note another aspect of our place in the present fabric of civilization. Our guild is like a great army, constantly in need of new recruits in the ranks of the younger strata as its numbers become depleted by age and casualty in those of the older. This is, in short, the great problem of the renewal of personnel and translates itself into the problem of education for those who are planning to enter our ranks.

It will probably not be claimed that either as individuals or as societies have we in general shown the degree of interest in this subject of engineering education which its importance requires. The technical schools and colleges are intended to furnish opportunity for the effective training of those of our youth who are to furnish at least a very considerable quota of the new recruits in our ranks. Other things equal, we are more likely to find the leaders of future years among those who have been so trained. Of what vital importance it is, then, that we should cooperate with those whose duty it is to direct these great educational activities, to the end, on the one

hand, that their measures may be taken with full knowledge of the ever-changing requirements on the firing line of the profession, and on the other, that those who are to receive these new recruits and direct them into the active work of their calling may do so with a sympathetic knowledge of the scope, character and necessary limitations of training which can be given in the course of a technical curriculum.

As one with some years of experience as a teacher, I am only too ready to admit the inadequacy, in some respects, of the training which our engineering and technical schools are now giving, and due in large degree, I believe, to the lack of sufficient contact between the schools and the fields of activity in which their output, as an educational product, is expected to take its place. On the other hand, I believe that some, at least, of the criticism which has been directed toward the product of our technical schools and colleges has arisen as a result of asking or expecting the wrong things of the neophyte—as a result of a lack of understanding or appreciation of the limitations with which the new recruit must approach his job. These conditions can certainly be vastly ameliorated by a better understanding on both sides. The schools and colleges are certainly desirous of such a better understanding and to us, as societies, the duty now comes, with a significance and an importance which it would be hard to exaggerate, to arouse ourselves to a more active interest in this subject of the training of the recruits for our guild, and to insure that, as far as may be humanly possible, this training shall be such as to best give a well-rounded development of the mental faculties, stimulate genius—if there be such a spark—and withal awaken and foster those characteristics which will make for accurate thinking, independence, originality, devotion to truth, leadership and high character.

As we know, a splendid beginning has been made toward this closer approximation of the educator and the requirements of the field of active practice, by way of the survey which is now being carried on through the agency of the Society for the Promotion of Engineering Education.

This is a subject of vital importance to the future of our engineering societies and to the whole future trend of progress along engineering lines. It should receive unqualified and wholehearted support from these societies, and nothing less will clear us of the obligation which we are under to prepare, as best we may, for the next generation of leadership in our guild.

THE ENGINEERING METHOD AND ITS APPLICATION TO PUBLIC QUESTIONS

The duties and obligations to which I have directed your attention thus far have lain in close relationship to our work as engineers. But there are wider duties and obligations. We are engineers and as such hold a position of peculiar trust and responsibility in connection with the progress of civilization. But we can not live unto our guild alone. We are citizens of a complex civilization and touch on every hand problems of life and destiny in which we must take some part.

In a sense, life is a complex of problems. The interrogation point presents itself to us on every hand and in regard to every relation in life.

But the solving of problems in his own field is, in a peculiar sense, the meat and drink of the engineer. His professional work is, in very large part, concerned with just this form of activity, and he has developed and used, consciously or unconsciously, a form of grand strategy which he has found absolutely essential for the effective study of these situations in life.

Thus he knows that a problem presents in general a complex of factors, and that as the first step such factors must be recognized and listed; and furthermore that such a census must be exhaustive—that no factor must be omitted. Again, he knows that such factors must be evaluated in one form or another, that their interactions must be studied—all with a view to their relations to the particular character of the conclusion which it is desired to draw.

And then with all this material in hand it must be subjected to some logical process—formal or informal—and a conclusion drawn. Often, in fact as a rule, the material resulting from the census and evaluation of factors is of necessity incomplete. In many cases the logical process must be informal rather than formal. In all such cases judgment must supply the missing elements if a solution is to be reached. However, no one knows better than the engineer the need of discrimination between the sure ground of known data and formal logic, on the one hand—as exemplified, say, by mathematical operations—and acts of judgment on the other; and no one has learned through wider experience than the engineer the need of applying his conclusions in the light of that component part which, of necessity, has been dependent on estimate and judgment.

But if such, in broad outline, are the characteristics of the grand strategy which the engineer is accustomed to apply in a study of problems in his own field, how or where could we find a better mode of approach for the study of all problems in life, whether of economics, diplomacy, international affairs, problems of the nation, of the state, of the municipality, of the school district, of trade and commerce, of finance, of education—in a word, of all relations in

life which go to make up the complex of our modern civilization?

This does not mean of course that the engineer as such can pose as an expert in the study of problems in these varied fields remote from his own normal activity. It does mean that his own general grand strategy is equally applicable in such fields as in his own, and therefore to that extent is he qualified to serve effectively with others who may be able to supply the more narrowly technical details, in the study of a wide variety of problems in life and lying outside his own special field. It means, in particular, when such problems involve questions of engineering or when they have an engineering background, as is so frequently the case, that he is especially well qualified to take an important and helpful part in the broad and thorough study of such matters, and that in general, aside from narrow technicalities, he may helpfully join with his fellows from various walks of life in the effective study of a wide and important range of problems which lie outside the immediate limits of his own chosen field.

It is, in fact, perhaps not too much to say that as the engineering method, if we may so term it, is the more applied in our study of public questions, and broadly in that of the problems of life generally, so shall we be able to reach more sure and safe conclusions, and so will the engineer the more fully realize the degree of service which he may render to the cause of human progress.

CONCLUSION

To sum up the whole matter, the engineer, either as an individual or as a collective type, is simply a link in the chain of human progress—a chain the links of which, in one form or another, run back into a past removed from our own time by tens of thousands of years, to go to no higher figures. With the trend of human progress as it now is, he seems, moreover, to be a very necessary link. He has taken upon himself the peculiar function of developing and translating into use for the needs of civilization the constructive materials of the earth and the inorganic energies of nature, and in connection with the exercise of such function he has acquired peculiar and weighty duties and responsibilities.

There are naturally the duties of self-development and improvement, both individually and collectively, as organizations such as our own. This is the duty so well inculcated by the scriptural parable of the talents. Likewise there are the duties of friendship and of cooperation for the realization of larger ends, and again, both individually and collectively as organizations.

And then it is peculiarly the duty of the engineer to see that, so far as in him may lie, these stores of nature, of which he is the custodian, are used frugally, with due regard to their limited supply, and having in mind the needs of future generations. Again, it is his duty to leave behind him some definite increment to that great store of knowledge through which we are able to enter into partnership with nature, and only by means of which we may hope to more effectively align ourselves with her laws and thus maintain an ever-ascending gradient of human progress.

Again we must individually as we may, and collectively with definite purpose, endeavor to cooperate helpfully with agencies charged with the training of recruits for our ranks, to the end that there may be a continued and adequate supply to the younger strata in our guild, whence we may hopefully look for leadership and guidance in the future.

And finally, since in the exercise of his functions as an engineer he must of necessity develop and employ habits of mind and methods of study which may be usefully employed in dealing with problems as they arise in all activities in life, therefore should the engineer stand ready to serve, not only in his chosen sphere, but wherever and whenever his habit of mind, his training and his experience may enable him to contribute a helpful element in this great cooperative enterprise which we call civilization.

W. F. DURAND

STANFORD UNIVERSITY

BIOLOGICAL ABSTRACTS

BECAUSE of numerous inquiries concerning the status of plans for *Biological Abstracts*, the following brief statement is presented:

Historical.—It will be recalled that in 1923 the joint publications committee of the Union of American Biological Societies, the division of biology and agriculture of the National Research Council and the American Association for the Advancement of Science made a report[1] on the general status of literature aids in biology and tentatively outlined a project for the establishment of an inclusive abstracting and indexing service for the entire field of theoretical and applied biology. The secretary of the union submitted this report to members of the larger research biological societies with a request that the individual biologists examine the proposal and express themselves frankly concerning it. The joint publications committee has reported[2] on the 4,500 replies received in this "referendum," about 85 per cent. of which favored the project and 65 per cent. expressed tenta-

[1] SCIENCE, September 28, 1923, pp. 236–239.

[2] SCIENCE, November 28, 1924, pp. 485–489.

tive willingness to subscribe individually. Meanwhile, personal conferences with biologists and organizations in other parts of the world disclosed a general sympathetic interest in the possibility of establishing the inclusive service.

With these assurances of cooperation and support, the project has finally become possible of execution through the generous action of the Rockefeller Foundation pledging $350,000 in support of the editorial conduct of the service, the funds being available over a ten-year period. Although the support is pledged to the Union of American Biological Societies, the funds are appropriated through the National Research Council.

The new journal, *Biological Abstracts,* will begin its work with the literature of 1926; the first issue may, therefore, be expected about May or June, 1926. For 1925, however, some funds were made available to carry on necessary organization activities and to support the editorial work in *Botanical Abstracts* and *Abstracts of Bacteriology,* both of which will merge into *Biological Abstracts.*

General Organization.—Except during its first year, the journal will be issued in twelve monthly abstract numbers, the annual volumes, which will coincide with the calendar year, closing with an index issue. The abstracts will be printed in English, but all authors' names, titles and citations in so far as they appear in Latin- or Slavic-letter languages will be printed in the original. The abstracts appearing in the issues will be grouped into convenient and reasonably homogeneous subject-matter sections, each in charge of a specialist who will act as section editor. A small central editorial office and staff will be charged with the responsibility of securing all necessary abstracts, distributing these periodically to section editors, and exercising general editorial supervision; preparing provisional manuscript of all indexes; attending to proof reading and seeing all issues through the press; arranging for detailed business management of the journal, etc. Some aspects of the plans and work merit a fuller statement.

Cooperation from Biological Groups.—The small central editorial staff is evidently unable to pass competently on all policies and detailed procedure affecting special interests. Many of the larger research biological societies, whether they happened to be members of the union or not, were therefore invited to name advisory committees to cooperate with the editors in dividing the biological field into suitable subject-matter sections and choosing section editors, preparing lists of possible collaborators (abstractors), determining indexing policies, etc. In this way it is hoped that throughout the broad field to be covered and the extensive constituency to be served reasonable competence will be brought to bear on the problems involved. Fourteen such advisory committees have been appointed and are actively cooperating.

Preparation of Abstracts.—With few exceptions no abstracts will be prepared by the section editors or in the central editorial office, though the latter will issue all requests for abstracts and administer any necessary follow-up. It is hoped to secure, if possible, virtually all abstracts from collaborators resident in the countries in which the various publications, especially serials, are published, each collaborator, however, being invited to assume only a very moderate and non-burdensome responsibility. It is therefore the plan to produce the journal through cooperation coextensive with productive activity in biological science. More specifically, it is the plan to secure abstracts mainly in the following three ways:

(1) Through authors, who will be invited by the central editorial office to submit abstracts of specifically designated articles of their own authorship.

(2) Through collaborators responsible for furnishing all necessary abstracts and titles from one or a limited number of specifically designated and assigned serial publications. This procedure will be followed only in those journals which confine themselves to a limited special field and the contents of which therefore readily fall within the competence of a single specialist.

(3) Through collaborators who will be invited to abstract individually designated papers falling within their special interests and linguistic equipment. This procedure will be followed in cases in which it is not possible or practicable to secure the abstracts by one of the first two methods.

In addition, abstracts will in some cases be secured from other abstracting journals with which cooperative relations have or may be established.

The abstracts will not attempt to evaluate contributions. No arbitrary limit is placed on the length of abstracts; it is the policy to have them as long as necessary to fulfill their primary functions—permit adequate and accurate indexing of the corresponding original articles and acquaint the reader with the more important new information authors believe that they have contributed. Collaborators and authors will be free to prepare abstracts in any one of five or six languages, depending entirely upon their convenience; any necessary translations will be arranged for by the central editorial office.

Subject-matter Sections.—With the invaluable and generous cooperation of the various advisory committees and many individual biologists, the field to be covered by the service has been divided into some eighty sections to which the abstracts are to be allocated by the central editorial office. No scheme

of sections can meet fully the special desires of all; this is generally recognized and the editors have encountered only the most generous spirit of give-and-take between groups as these have collaborated in arriving at a tentative division which gives promise of approximating greatest convenience to the greatest number. It is to be remembered that the grouping of abstracts into sections serves a useful purpose chiefly during current reading; the indexes, the only effective avenues of approach when abstracting journals are later used, are prepared without reference to the sections in which the abstracts were printed, and any inconvenience growing out of misallocation of abstracts or unwise delimitation of sections is thus only temporary. Since the sections are intended to serve the convenience of the greatest number, they are subject to change as experience may dictate. A further provision which will aid in reducing the inconvenience growing out of the necessity for sections and the printing of but a single abstract of any one paper (in the interests of economy), is the system of cross references; this will be within the complete control of each section editor and is discussed in more detail below.

Indexes.—The indexes give to an abstracting service permanent reference value; special attention has, therefore, been given to this aspect of the organization work. The concluding (thirteenth) number of each annual volume will be devoted to the indexes, of which three have been definitely planned, as follows:

(1) Authors' index.
(2) Detailed analytical alphabetic subject index.
(3) Subject index arranged by systematic groups.

An index to new genera, and other special aids, can be added if this is deemed necessary.

It is recognized that the limited indexing staff in the central editorial office will not be thoroughly competent to pass finally on all entries to appear in the two subject indexes. On the other hand, the section editors can not be expected to do the laborious mechanical work of preparing the subject-index entries for the abstracts appearing in their sections. A procedure has, therefore, been worked out whereby the manuscript of the alphabetic and systematic indexes for each abstract is prepared in the central office and attached to the corresponding abstract before this is sent to the section editor. By this plan the various specialists (section editors) will have full opportunity to edit critically not only the abstracts, but the individual index entries as well, without, however, being burdened with detailed mechanical preparation. In this way it is hoped that all index material will have adequate editorial attention; also, index entries will be completely prepared before the corresponding abstracts go to press, thus reducing to the minimum the delay in the appearance of the annual indexes.

Section Editors.—Section editors will be clothed with full editorial prerogatives. At regular intervals, probably once a month, all accumulated abstracts, with attached index manuscript, will be distributed to the section editors from the central office. Wherever possible, the corresponding original articles will also be furnished; in the measure that this can be done section editors will have all necessary facilities for adequate editorial supervision of both abstracts and indexes.

Since but one abstract of any one article is to be printed (in view of the great economy effected), material of interest to the readers of a given section will often appear in other sections. In order that practically all material germane to any one section may be represented in that section, editors will be provided with galley proof of as much of each issue as they may request from which they may gather all cross references deemed desirable for insertion in their respective sections. Each editor will thus have complete control also of the cross references appearing in his section.

It is obvious that section editors occupy key positions and have the opportunity to render a fundamental service to their colleagues the world over. The endeavor of the central editorial staff will be to take from the shoulders of section editors as much detail and drudgery as possible and leave them reasonably free for those functions that are editorial in the best sense of the term. Under these conditions it is expected that there will be a sufficient number of biologists with the requisite equipment willing to man these very important posts.

Physical Make-up of the Journal.—In this direction the effort has been to keep down bulk without sacrificing legibility. A double-column page similar to that in SCIENCE and set in eight-point solid type has been adopted. This page has a capacity 88 per cent. greater than that of *Botanical Abstracts*, though the size of the page is only very slightly larger; also, the legibility is generally conceded to be greater than in *Botanical Abstracts* with its 5-inch single column, though the size of the type is the same. By this arrangement the original estimate of the number of pages annually necessary to cover the biological literature in abstracts and indexes is nearly halved.

With the cooperation of the Bureau of Standards and paper manufacturers, a rather exhaustive study

has been made of available high-grade, thin, opaque papers. The one selected for the journal bulks 1,030 pages to the inch and meets with very general approval.

With this advantageous combination of format, typography and paper an inch of shelf room occupied by *Biological Abstracts* will accommodate about five times as much material as one occupied by *Botanical Abstracts*. It is now reasonably certain that for some years to come annual volumes of *Biological Abstracts* will not occupy more than three to four inches of linear shelf space, which is less than the space now occupied by a year's issues of *Botanical Abstracts* alone.

Central Editorial Staff and Office.—Members thus far appointed are: J. A. Detlefsen and F. V. Rand, associate editors; and J. R. Schramm, editor-in-chief.

From among several extended, it has been decided to accept the generous invitation of the University of Pennsylvania to house the office in the zoology building. The exceptional current library facilities in Philadelphia itself and its strategic position among the great library centers of the east were dominant factors in the decision.

Business Management and Subscriptions.—For the present at least, the business management of *Biological Abstracts,* including subscriptions and advertising, will be conducted in the central editorial office. Subscription rates have not been finally determined, but it is reasonably certain that they will be within the estimates originally made by the joint publications committee.[3] Early in the coming year announcements will be made and communications sent to individuals and institutions regarding subscriptions. Inquiries relative to subscriptions and advertising should be sent to *Biological Abstracts,* University of Pennsylvania, Philadelphia.

J. R. SCHRAMM

UNIVERSITY OF PENNSYLVANIA,
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HAROLD WILLIAM NICHOLS

DR. HAROLD W. NICHOLS, a radio research engineer of the Bell Telephone Laboratories, died on November 14 at his home in Maplewood, New Jersey. He was born in Iowa on February 23, 1886, and received his education at Armour Institute of Technology, Chicago, receiving a B.S. degree in 1908 and E.E. in 1911; and at the University of Chicago from which he received the degree of M.S. and Ph.D.

In July, 1914, he joined the Bell Telephone Laboratories in New York City. He rapidly achieved distinction in the radio research activities of that organization, and during the world war he was in charge of its radio work. During recent years he has been identified prominently with the investigations of ship-to-shore radio telephone service and of short waves in radio communication. He is recognized as an authority on "fading"; his papers on this phase of radio are distinct contributions to the art. He took a leading part in the transatlantic radio telephone tests in 1923, and for a lecture on this subject received the Radio Premium from the British Institution of Electrical Engineers. He had twenty inventions pertaining to the radio art to his credit and nine applications are now pending.

Dr. Nichols was a member of the American Institute of Electrical Engineers; the American Mathematical Society; the American Physical Society; the Institute of Radio Engineers; and the Sigma Xi and Eta Kappa Nu fraternities.

His associates in the Bell Telephone Laboratories regard his death as a distinct loss to the profession as well as a great personal loss to themselves. He was a man of pleasing personality; an efficient and untiring worker, noted for his judgment and insight into all phases of the art of radio.

Dr. Nichols is survived by his widow, formerly Miss Lois Boardman, and two children.

[3] SCIENCE, September 28, 1923, pp. 236–239.

SCIENTIFIC EVENTS

THE AMERICAN-HUNGARIAN FOUNDATION LIBRARY

THREE or four years ago the American-Hungarian Foundation was organized by a group of men, chiefly in Lansing and East Lansing, Michigan, but including others from Chicago, New York, Detroit, Cleveland and other parts of the country, for the purpose of furthering the mutual educational interests of Hungary and America.

One of the objects accomplished was the exchange of professors between the two countries. In the fall of 1924, Professor Geza Doby, professor of biochemistry in the economic faculty of the University of Budapest, and Professor Alexander Kotlan, of the Royal Veterinary College of Budapest, were brought to Michigan State College as visiting professors for the college year. This current year Professor H. J. Stafseth, of the department of bacteriology, Michigan State College, is an exchange professor at Budapest at the Royal Veterinary College.

One of the important things brought out by this exchange is the great interest expressed by the Hungarian scientists for American scientific work. Owing, however, to the very unfavorable rate of exchange for Hungarian money, it is practically impossible for

Hungarian scientists to subscribe for American periodicals. An arrangement has been effected through the American-Hungarian Foundation for the establishment of a loan library at Budapest. From this library, under restrictions to prevent loss and too great a delay in the circulation of the material, any responsible scientist in Hungary may borrow such books, periodicals or separates as are available, returning these at the earliest possible moment.

It is urged that American scientists send to this library the copies of their separates. Particularly, it is urged that where possible four or five copies be sent, but if that is impossible, at least one copy. It is hoped that a generous response may be made to this appeal and that this library may be placed on the permanent mailing list of those who maintain mailing lists for their separates. Articles in the so-called pure sciences, as well as in the sciences that have more direct application to agriculture and the industries, are desired, as well as separates along the special industrial and agricultural lines.

It is very fortunate that the international exchange of literature by the Smithsonian Institution can be made use of in forwarding these separates to Hungary. Each batch of separates should be addressed on an inner wrapper as follows:

American-Hungarian Foundation Library,
Közgazdasági Egyetem,
Szerb Utca 23,
Budapest IV, Hungary,

and at the upper lefthand corner should be placed the name of the sender. This should be enclosed in an outer wrapper, addressed to the Smithsonian Institution, International Exchanges, Washington, D. C. The name of the sender should appear on this wrapper also. At the same time a postal card or letter should be mailed to the Smithsonian Institution, stating the number of packages being sent to it and the name and address of the consignee. This is important for the completeness of the Smithsonian Institution's records. Postage should be prepaid to Washington but no postage should be placed on the inner wrapping. As these packages accumulate, they will be forwarded to Budapest.

ERNST A. BESSEY

MICHIGAN STATE COLLEGE

THE CARNEGIE CORPORATION GRANTS

REPORTS of progress during the fiscal year 1924–25 made by the recipients of large grants from the Carnegie Corporation of New York are made public in the annual report of President F. P. Keppel, presented at the annual meeting of the corporation trustees. These include grants for scientific purposes to the following institutions and organizations, the amount of the grant reported representing in many cases support accorded over long periods of years:

Engineering Study of the Society for the Promotion of Engineering Education, $108,000; Food Research Institute at Stanford University, California, $704,000; Vanderbilt University, for endowment of the Medical School, $1,500,000; University of Colorado Medical School building, $100,000; Columbia University and the Presbyterian Hospital of New York building, $1,000,000; the Johns Hopkins University Medical School, for an Out-Patient Building and Diagnostic Clinic, $2,000,000; New York Academy of Medicine building, $1,550,000; Junior College, St. Johns, Newfoundland, $75,000.

Among the more important grants made during the current year for scientific purposes are the following: Carnegie Institution of Washington, endowment and support of activities, $5,712,500; California Institute of Technology, $100,000; Meharry Medical College for library and laboratory endowment fund, $50,000; New York Academy of Medicine, supplementary appropriation for building, $550,000; Oberlin College, for the library endowment fund, $50,000; Western Reserve University, emergency appropriation for School of Library Science, $21,000; American Museum of Natural History, for support of educational facilities, $75,000; Franklin Foundation of Boston, for organization of additional courses, $50,000; Institute of Educational Research of Teachers College, for study of psychology of adult education, $47,000; Association of American Medical Colleges, for study of medical education, $40,000; Potter Metabolic Institute of Santa Barbara, California, for research in the production of insulin, $15,000.

ELECTIONS OF THE AMERICAN SOCIETY OF AGRONOMY

AT the meeting of the American Society of Agronomy, held in Chicago on November 16 and 17, the following officers were elected:

President—Director C. G. Williams, Wooster, Ohio.
Editor—Dr. R. W. Thatcher, Agricultural Experiment Station, Geneva, N. Y.
Secretary-Treasurer—Dr. P. E. Brown, Iowa State College, Ames.
First Vice-president—Dr. W. L. Burlison, University of Illinois, Urbana.
Second Vice-president—Director M. J. Funchess, Alabama Agricultural Experiment Station, Auburn.
Third Vice-president—Dr. E. F. Gaines, Washington State College, Pullman.
Fourth Vice-president—Dr. A. G. McCall, Maryland Agricultural Experiment Station, College Park.

Dr. W. M. Jardine, secretary of agriculture, was elected an honorary member. Dr. Jardine has been

a member of the society since 1908 and held the office of president for one year. He has the distinction of being the only member who now holds the rank of honorary member.

Twelve of the leading agronomists of the country were elected to fellowships by the society. The following are those who were thus honored:

Dr. C. R. Ball, Bureau of Plant Industry.
Dr. P. E. Brown, Iowa State College.
Dean L. E. Call, Kansas State Agricultural College.
Director S. B. Haskell, Massachusetts Agricultural Experiment Station.
Dean Jacob G. Lipman, Rutgers University.
Dr. T. L. Lyon, Cornell University.
Professor M. F. Miller, University of Missouri.
Dr. C. V. Piper, Bureau of Plant Industry.
Director R. W. Thatcher, N. Y. Agricultural Experiment Station.
Dr. Chas. E. Thorne, Ohio Agricultural Experiment Station.
Dr. C. W. Warburton, Extension Division, U. S. Department of Agriculture.
Dr. C. A. Zavitz, Ontario Agricultural College.

LATE NOTES ON THE KANSAS CITY MEETING OF THE AMERICAN ASSOCIATION

THE general headquarters hotel for the Kansas City meeting will be the Muehlebach. There has been some uncertainty, but this is now definite. The executive committee will hold its sessions in the Muehlebach, in the permanent secretary's consulting room. The council will hold its sessions in the tea room.

The following are the headquarters hotels for the several groups. By following these assignments congestion will be largely avoided.

Mathematicians, Hotel Baltimore.
Physicists and *Meteorologists,* Hotel Kupper.
Chemists, Hotel Aladdin.
Astronomers, Hotel Kupper.
Geologists and *Geographers,* Kansas City Athletic Club.
General Zoologists, Kansas City Athletic Club.
Entomologists, Hotel Baltimore.
Parasitologists, Hotel Stats.
Ornithologists, Hotel Dixon.
Botanical Scientists, Hotel Baltimore.
Ecologists, Microscopists, Nature-Study Workers, Hotel Westgate.
Anthropologists, Hotel Muehlebach.
Psychologists, Coates House.
Social and Economic Scientists, Kansas City Athletic Club.
The Metric Association, Hotel Muehlebach.
Engineers, Hotel Muehlebach.
Medical Scientists, Hotel Baltimore.
Agronomists and *Horticulturists,* Hotel Baltimore.
Seed Analysts and *Potato Workers,* Hotel Savoy.
Education Scientists, Coates House.

The geneticists interested in agriculture are planning to hold a session on Monday, December 28, on the mezzanine floor of the Kansas City Athletic Club. The session is to be devoted to a symposium on "What genetics has contributed to practical plant and animal breeding," which will be led by Dr. E. W. Lindstrom, of Iowa State College, Ames, Iowa.

The Joint Genetics Section of the American Society of Zoologists and the Botanical Society of America will hold sessions Tuesday forenoon and Wednesday afternooon.

Upon arrival in Kansas City those attending the meeting should proceed at once to the registration room, in the Aladdin Hotel, which will be open from 9 to 9 on the first three days and from 9 to 5 on the remaining days. The general program will be available there, with full information on all details of the convention.

The sessions at Kansas City will necessarily be mainly held in hotels, but the hotels to be used are conveniently grouped. The local committee has cared for all details in an excellent manner. The meeting will be different in many respects from meetings held in university buildings, but it will surely be a real success and the unusual features of a hotel convention will constitute an interesting variation, more pleasant than otherwise.

BURTON E. LIVINGSTON,
Permanent Secretary

SCIENTIFIC NOTES AND NEWS

THE faculty of Wesleyan University presented to Dr. William North Rice, professor emeritus of geology, engrossed resolutions on his eightieth birthday on November 21. President McConaughy and Professor J. W. Hewitt made the presentation speeches.

THE gold medal of the Holland Society of New York was presented on November 23 to Professor Henry Fairfield Osborn, president of the American Museum of Natural History, in recognition of his achievements in the field of biological anthropology.

PROFESSOR ERNST COHEN, director of the Van't Hoff Laboratory at the University of Utrecht, Holland, will be the visiting professor of chemistry in Cornell University during the second semester of this academic year. Professor Cohen will be the first of a succession of scientific men to occupy the new nonresident chair of chemistry established here by the anonymous gift to the university of $250,000, which was recently announced.

THE resignation by Professor A. V. Hill of the Jodrell chair of physiology, tenable at University College, London, has been accepted, with effect from

December 31, 1925. It is said, however, that this will not terminate Professor Hill's connection with University College.

DR. FRIDTJOF NANSEN, the explorer, has had conferred upon him the honorary LL.D. by the University of Athens.

DR. C. CHAGAS, chief of the public health service of Brazil, was presented with the honorary gold medal of the Hamburg medical faculty when he spoke recently at the Institute for Tropical Diseases on "Chagas's Disease: Brazilian Trypanosomiasis." He delivered a similar address before the Medical Society of Berlin.

THE Royal Meteorological Society has awarded the Symons gold medal for 1926 to Lieutenant-Colonel Ernest Gold, assistant director of the Meteorological Office. The medal will be presented at the annual general meeting on January 20.

DR. ALBERT F. GAINER, of Nashville, was elected president of the Tennessee Academy of Science at the closing session of the Nashville meeting on November 28. He succeeds Scott R. Lyon, of Southwestern University, Memphis. C. A. Moore, University of Tennessee, was named vice-president, and Dr. J. T. McGill and Dr. G. R. Mayfield, Vanderbilt, were chosen secretary-treasurer and editor, respectively.

AT the annual meeting of the London Mathematical Society, held on November 12, Dr. A. L. Dixon, Waynflete professor of pure mathematics at Oxford University, was elected president.

DR. J. T. WILSON, professor of anatomy at the University of Cambridge, has been elected president of the Cambridge Philosophical Society.

DR. HARRY H. LAUGHLIN, of the Carnegie Institution of Washington, has been appointed a member of the Permanent Emigration Commission, which has been established by the International Labor Office of the League of Nations.

DR. ALFRED W. FRANCIS has resigned a National Research Fellowship in chemistry at the Massachusetts Institute of Technology in order to join the research staff of the Arthur D. Little Company, Inc., of Cambridge, Mass.

E. F. KELLEY has been appointed to succeed A. T. Goldbeck, who recently resigned, as the chief of the division of tests and research of the Bureau of Public Roads.

DR. WALTER F. RITTMAN, of the Carnegie Institute of Technology, has been appointed consulting chemical engineer to the Fixed Nitrogen Research Laboratory of the Department of Commerce.

THE *Brazil Medico* states that Dr. Afranio Amaral, formerly head of the Butantan Institute, has been requested by Harvard University to organize the laboratory for research on animal venoms there.

DR. BERNARD A. GALLAGHER, who was for several years in the Bureau of Animal Industry, has been appointed bacteriologist in the Division of Animal Husbandry, Hawaiian Islands.

CONRAD KINYOUN, assistant bacteriologist in the Hygienic Laboratory, U. S. Public Health Service, has been appointed director of the Public Health Laboratories of Savannah.

PROFESSOR F. L. WASHBURN, of the University of Minnesota, will give up university work in July, 1926, having reached the retiring age. He will at that time have been connected with the Minnesota institution for twenty-four years, during fifteen of which he was state entomologist. At present Professor Washburn is collecting insects for the university in the Tuamotu Archipelago and Society Islands of the South Pacific.

DR. H. J. WEBBER, professor of subtropical horticulture and director of the Citrus Substation at the University of California, recently returned after a year's absence on sabbatical leave. During this time Dr. Webber served as a special commissioner of the departments of agriculture of the Union of South Africa and of Southern Rhodesia, making a study of the methods of citrus culture used in these countries.

PROFESSOR STEPHEN BRUNER, of the Agricultural Experiment Station, Santiago de las Vegas, Havana, recently visited Washington, to examine the collection of insects at the National Museum.

DR. VERNON KELLOGG, secretary of the National Research Council, will give the annual public address of the Entomological Society of America at the Kansas City meetings of the American Association for the Advancement of Science. The subject of the address is "Cooperation or Isolation in Science."

DURING the week of November second Professor R. E. Swain, of Stanford University, gave a series of five lectures on biochemistry and human welfare before the department of chemistry at the University of Arizona and the Arizona Section of the American Chemical Society.

DR. ARTHUR S. KING, superintendent of the physical laboratory at Mount Wilson Observatory, gave an illustrated lecture on "Laboratory Methods of Analyzing Spectra, with Application to Atomic Structure," at the Carnegie Institution of Washington, on December 8.

JAMES A. TOBEY, of the Institute for Government Research, Washington, D. C., lectured on public health law at the Massachusetts Institute of Technology on November 27, and will lecture on the same subject at the Harvard School of Public Health early in January.

THE second Ludvig Hektoen lecture of the Billings Foundation was given on November 27, before the Institute of Medicine of Chicago by Dr. Edward Francis, director of the Hygienic Laboratory, U. S. Public Health Service, whose subject was "Tularemia." The sixth Pasteur lecture of the Institute of Medicine has been postponed until January.

PROFESSOR C. W. STILES, of the U. S. Hygienic Laboratory, presented two lectures on poisonous snakes at the meetings of the research club in medical zoology at the School of Hygiene and Public Health, the Johns Hopkins University, on November 23 and 30.

J. M. WESTGATE, agronomist in charge of the Federal Agricultural Experiment Station, Honolulu, addressed the Science Club of Kansas State Agricultural College on November 30 on "Agriculture in the Hawaiian Islands." Mr. Westgate has been in charge of the Federal Agricultural Experiment Station in Honolulu during the past ten years.

DR. WILLIAM RANDOLPH TAYLOR, of the department of botany at the University of Pennsylvania, recently addressed the botanical seminar on the results of his summer's work on the algae of the Dry Tortugas, done under the auspices of the Carnegie Institution. About 300 species have been collected and identified.

PROFESSOR V. PUTTI, of Italy, lectured before the Harvard Medical Society at the Peter Bent Brigham Hospital, Boston, on November 30 on "The History of the University of Bologna."

DR. R. MAGNUS, professor of pharmacology at Utrecht, delivered the Croonian lecture at the College of Physicians, London, in October. His subject was "The Influence of Unconscious Reflexes on Movement and Attitude." The Baly medal was presented to him at the same time.

THE twelfth biennial Huxley lecture was delivered by Sir Oliver Lodge, F.R.S., on December 3 at Charing Cross Hospital. The subject was "Recent Advances in Science in Their Relation to Practical Medicine."

THE name of Henry C. Wallace, of Iowa, secretary of agriculture at the time of his death last year, has been honored by the United States Geographical Board in naming a 10,600-foot peak in Park County, Montana, in the Absaroka Range, as Mount Wallace. The decision was made on recommendation of the Forest Service.

DR. CHARLES A. DOREMUS, formerly professor of chemistry and toxicology at the University of Buffalo and later at the College of the City of New York, died on December 2 at the age of seventy-four years.

DR. ALBION WALTER HEWLETT, professor of medicine at the Stanford University School of Medicine, died on November 10, aged fifty-one years.

ON November 12, C. N. Catlin, associate professor of agricultural chemistry at the University of Arizona, died following an operation for appendicitis. Professor Catlin had been at the university since 1912 and has published a number of bulletins on various phases of soil chemistry.

COLONEL WILLIAM R. LANG, formerly professor of chemistry at the University of Toronto, died on November 20.

DR. JOSÉ INGENIEROS, professor of experimental psychology at Buenos Aires, author of numerous works on biologic psychology and sociology, has died.

M. J. NICOLL, formerly assistant in the Zoological Gardens in Cairo, the author of numerous ornithological papers, died on October 31, aged forty-five years.

DR. THEODOR FUCHS, corresponding member of the Vienna Academy of Sciences and honorary director of the geological and paleontological section of the Natural History Museum in Vienna, died on October 3.

DR. CARL KUPELWIESER, a founder of the Institute for Radium Research at Vienna and of the Biological Station at Lunz, died on September 16.

THE Federation of American Societies for Experimental Biology, formed by the Physiological Society, the Society of Biological Chemists, the Society for Pharmacology and Experimental Therapeutics and the Society for Experimental Pathology, will hold its annual meeting at Cleveland, Ohio, on December 28, 29 and 30. The local committee consists of Howard T. Karsner, *chairman;* J. M. Rogoff, L. J. Morris and C. J. Wiggers. These can all be reached by addressing the School of Medicine, Western Reserve University, 2109 Adelbert Road. The two joint sessions will be held at the Hotel Statler Ball Room. All the other meetings will be held at the Medical Building of Western Reserve University Medical School. On Monday at 7:00 p. m. at the Mid-Day Club, Union Trust Building, East Ninth and Euclid, a dinner will be tendered the members of the federation and their wives by Western Reserve University. Addresses will be delivered by Dr. R. E. Vinson, president of the

university; Hon. W. R. Hopkins, city manager of Cleveland, and Professor A. J. Carlson, president of the federation. Tickets for this dinner will be distributed in the corridor of the ball room, Hotel Statler, from 9:00 a. m. to 12:00 noon on Monday. Non-members who wish to attend may secure tickets at $3.00 per cover at the same time and place. On Tuesday at 7:00 p. m., at the Hotel Statler, the annual subscription dinner of the federation will be held. Tickets at $3.50 per cover will be on sale at the information window of the school of medicine on Monday afternoon, December 28, and before 12:00 noon on Tuesday, December 29.

FREE lectures and demonstrations are being given by the New York Botanical Garden in the central display greenhouse, conservatory range 2, on Saturdays at 3 p. m., as follows: December 5—"Tropical Gardens," Mr. K. R. Boynton; December 12—"Greenhouse Pests," Dr. F. J. Seaver; December 19—"Air-plants," Dr. H. A. Gleason; January 9—"Starch-bearing Plants," Dr. Marshall A. Howe; January 16—"Variegated Plants," Dr. A. B. Stout; January 23—"Cycads," Dr. John K. Small; January 30—"House Plants and Their Care," Mr. H. W. Becker.

THE Captain Field Paleontological Expedition to Argentina, led by Elmer S. Riggs, associate curator of paleontology in the Field Museum, Chicago, will resume research work in South America at the close of the present year. Special efforts will be made to secure a representative collection from the Pliocene formation, also to secure specimens of the great Pleistocene mammals from the Pampean region. The latter will, according to Dr. Riggs, be especially sought after because of their great size, unique characteristics and their consequent value as museum exhibits.

AN Italian scientific expedition has left Rome for Trans-Jubaland (the district on the right bank of the Juba recently ceded to Italy by Great Britain), where it will set up an astronomical observatory for the purpose of studying the total eclipse of the sun on January 14 next.

THE United States Civil Service Commission announces an open competitive examination for junior aquatic biologist to be held at various places (a list of which will be furnished by the U. S. Civil Service Commission on request), on or before December 26. The examination is to fill a vacancy in the United States Bureau of Fisheries, Department of Commerce, at Key West, Florida, and in positions requiring similar qualifications, at an entrance salary of $1,860 per annum.

JOHN D. ROCKEFELLER has pledged a fund of $250,000 to the American Petroleum Institute, New York, "for the initiation of a program of scientific research in petroleum." The purpose of this program is not merely to secure the carrying on of a limited scientific research by especially engaged workers, but to enlist a more general scientific interest in petroleum.

JOHN D. ROCKEFELLER, JR., has pledged $250,000 to the permanent funds of the Brooklyn Botanic Garden, on condition that the institution raise an equal amount for the same purpose.

THE National Research Council has granted the University of Chicago $10,300 for the support of work on the biology of sex under Professor Frank R. Lillie and Assistant Professor Carl R. Moore. The National Tuberculosis Association has granted the university $3,000 for the continuation of the study of the "Nutrition of the Tubercle Bacillus," by Dr. Esmond R. Long. The Carnegie Corporation, through the American Association of Museums, has granted the university $2,500 for the investigation of "museum fatigue," by Associate Professor Edward S. Robinson, of the department of psychology.

THE late Sir Francis Darwin has bequeathed all books written by his late father Charles Darwin, all originals of his late father's letters addressed to him and all books written by members of the Darwin family to his son Bernard; all scientific books formerly belonging to his father, his collection of pamphlets and reviews and notices of his late father's publications to the professor of botany in the University of Cambridge for the Library of the Botanical Laboratory; his copyrights, all other papers having reference to his late father and all his scientific manuscripts, to his trustees to manage in their discretion for the benefit of his estate; £100 each to Albert Charles Seward, professor of botany in the University of Cambridge, and Frederick Frost Blackman, teacher of botany in the University of Cambridge.

LAST spring Dr. Wm. Schaus carried on a successful campaign to raise the money for the purchase of the Dognin collection of lepidoptera for the National Museum. Mr. Dognin, a well-known French lepidopterist, offered his collection for $50,000. This amount Dr. Schaus succeeded in raising, largely among his personal acquaintances. In the early summer he went to France, accompanied by Mr. J. T. Barnes as assistant, and they personally attended to the packing of the collection, which reached the National Museum in good condition in September. It contains about 82,000 specimens of butterflies and moths, among which are types of about 3,300 species, nearly all American. This is the second notable addi-

tion to the division of insects within the year, the first having been the late Colonel Thos. L. Casey's large collection of coleoptera. These collections represent the life work of two distinguished entomologists and are the greatest additions which the division of insects has ever received since its establishment, except the gifts of Dr. Schaus himself.

THE biology department of the Utah Agricultural College have combined to offer a special seminar course in evolution during the current school year. This course, which was started over a month ago, consists of a series of lectures on different phases of the subject of evolution given by members of the college faculty and by visiting lecturers. Beginning with a discussion of the probable origin of the solar system it will cover various phases of the evolutionary problem, including not only the probable origin and evolution of life but social origins and the origin and evolution of religion. The course is being offered primarily for students in the departments of biology and credit will be granted to those students who complete certain definitely assigned work. The lectures are open, however, to the general public and have created a great deal of interest in Logan, where the college is located.

DR. FREEMAN F. BURR, of the department of geology at St. Lawrence University, writes: "Short talks on geology are broadcast from Station WCAD, St. Lawrence University, Canton, N. Y., every Saturday morning at 11 o'clock. The talks are popular in form, and are given with the intention of stimulating general interest in geology. The department of geology would greatly appreciate criticisms and suggestions from geologists and others who may chance to listen in."

AT a meeting of the grand council of the British Empire Cancer Campaign held on October 13, it was announced that grants made, since the formation of the campaign over two years ago, to existing laboratories, new schemes of research, purchase of radium, and commitments, including the formation of the *Journal of Abstracts* and its maintenance, amount to over £75,000. On the recommendation of the Scientific Advisory Committee, the Grand Council approved of a grant of £1,000 per annum for six years to Dr. Thomas Lumsden, at the Lister Institute of Preventive Medicine, to enable him to relinquish his private practice and to devote his whole-time services in continuing his experimental work on sera in connection with seeking a cure for cancer and other allied lines of research. The application of Dr. J. C. Mottram, to whom the campaign has already made a grant of £808 to bring his scheme of research into line with the recent discoveries of Dr. Gye and Mr. Barnard, was approved. A further grant of £200 was made to Dr. Louis Cassidy, of the Coombe Hospital, Dublin, and the Grand Council confirmed the grant which was made to Professor Leiper, of the London School of Hygiene and Tropical Medicine, of £100 to carry out certain investigations in Northern Italy.

THE *British Medical Journal* states that on the suggestion of Lieutenant-Colonel F. P. Mackie, director of the Bombay Bacteriological Laboratory, it has been decided by the Government of Bombay that this laboratory shall henceforth be known as the Haffkine Institute. In proposing the change, Lieutenant-Colonel Mackie pointed out that the laboratory was started in 1896 by Professor Haffkine, for the preparation of his plague prophylactic; it was then housed in a small building in Byculla. The work rapidly increased, and in 1899 the laboratory was moved to the position it occupies now in Old Government House; it was renamed the "Plague Research Laboratory." Later, in 1905, the work of a provincial laboratory was added to that of plague research, and in the following year it received the title the "Bombay Bacteriological Laboratory" to cover its wider function, which includes plague research and diagnosis, an antirabic unit, a biochemical unit, and a pharmacological unit for the study of indigenous drugs. Since its establishment over twenty-five million doses of plague prophylactic have been issued.

ACCORDING to the Italian correspondent of the *Journal* of the American Medical Association the new institute of the history of science in Florence was opened recently, under the direction of Professor A. Corsini, a noted fosterer of the history of medicine and secretary of the Società italiana di storia delle scienze. The institute is located in the buildings of the faculty of medicine and is under the sponsorship of the rector of the University of Florence, Giulio Chiarugi, professor of normal human anatomy, and of Professor Lustig, dean of the faculty of medicine. The object of the new institute is to collect books, pamphlets, objets d'art, armamentarium and whatever else may serve to illustrate the various periods of the history of science, and, more particularly, of medicine, in order that they may be of use to students. There is a reawakened interest in such subjects in Italy. The nucleus of the institute comprises collections of antique surgical instruments; mortars and other instruments of ancient pharmacists; pictures, busts, journals, etc.

THE British Research Association for the Woolen and Worsted Industries announces the following awards for the year 1925–26: Research fellowships

have been granted to Mr. J. E. Nichols, to enable him to continue his researches at the Animal Breeding Research Department of the University of Edinburgh on the fibers of various breeds of sheep, and to Miss J. S. S. Blyth, to conduct research at the same department on the microscopical examination of the fleeces of British breeds of sheep. Advanced scholarships have been awarded to Mr. H. S. Bell, tenable at University College, Nottingham; and to Mr. W. Riddle, tenable at the Scottish Woolen Technical College, Galashiels.

UNIVERSITY AND EDUCATIONAL NOTES

A GIFT of $750,000 to the University of Rochester fund from the General Education Board has been announced. The gift brings the contributions to the fund from this source up to $1,750,000 and makes the total of the fund $9,250,000.

THE first list of subscriptions in reply to Leeds University's appeal for half a million pounds includes donations and promises amounting to over £111,000.

DR. HENRY LAURENS, associate professor of physiology in the Yale University School of Medicine, has been appointed professor of physiology to succeed Dr. Walter E. Garrey, who accepted a position last spring at the Vanderbilt University School of Medicine.

IN the bureau of economic geology of the University of Texas, Dr. E. H. Sellards, chief geologist, has been advanced to associate director. Mr. W. S. Adkins, formerly a member of the bureau staff and more recently engaged in private geologic work in Mexico, has returned as associate geologist. He has been given leave of absence for one year, which he is using in advanced study in France. Dr. John T. Lonsdale, formerly of the University of Oklahoma, has also been called to the place of associate geologist in this bureau.

DR. HOWARD FOX has been appointed professor of dermatology and syphilology at the New York University and Bellevue Hospital Medical College to succeed the late Dr. William B. Trimble.

ARTHUR CLARK TERRILL, professor of mining engineering at Pei Yang University at Tientsin, China, for the past four years, has returned to the United States and is now lecturer in geology at the California Institute of Technology.

DR. R. C. HUSTON was made professor of organic and biological chemistry at the Michigan State Agricultural College and H. L. Publow has been promoted from assistant to associate professor in chemistry.

PROFESSOR F. W. BURSTALL, head of the mechanical engineering department of the University of Birmingham, has been appointed vice-principal of the university, in succession to Sir William Ashley.

PROFESSOR G. TOGLIATTI, of Turin, has been appointed professor of applied mathematics at the University of Zürich.

DISCUSSION AND CORRESPONDENCE

"THE SCIENTIFIC ACCURACY OF THE SACRED SCRIPTURES"

REV. DR. W. B. RILEY, of Minneapolis, published some years ago a pamphlet with the above title. In it he insisted that the heavens were created first and the earth second, forgetting the fact that such a late intrusion of the earth would upset the balance of the whole solar system.

He asserted that many centuries ago in the Bible "the circulation of the blood" was set forth by the statement, "the Life is in the Blood," and that the law of gravitation was announced by the statement, "He hangeth the earth upon nothing."

On page 16 the text reads as follows:

> But the most remarkable instance of Scripture anticipation of science was the last discovery of T.N.A., the highest explosive ever known or conceived.
>
> It was conceded from the beginning of the late World War that the alliance discovering the highest explosive would win. Two young Americans—chemists—set themselves to that task. Knowing that snow and hail were contractions formed at 32 degrees above zero, while ice formed at thirty above and became an expansion, they took the explosive chemicals in liquid state and crystallized them by the temperature of hail and snow and lo, the result was a terror and Germany surrendered. [!] Then for the first time men knew what Job meant when he wrote 3,500 years ago, saying, "Hast thou entered into the treasures of the snow, or hast thou seen the treasures of the hail, which I have reserved against the time of trouble, against the day of battle and war?" —Job 38: 22.

My friend, Professor Charles E. Munroe, of the National Research Council, was at the head of the Chemical Explosives Service during the Great War. I sent him a copy of Dr. Riley's pamphlet and asked whether the statement as to the "two young American chemists" was correct. He replied, on June 16, 1922, that

> T.N.A. . . . was discovered by Dr. B. Y. Flurscheim, an English chemist, in 1904, and English patents, Nos. 3224 and 3907, were issued to him in 1910, as well as

patents in the United States and *Germany*, covering its use as an explosive. . . .

It is a more powerful explosive than T.N.T. It was proposed for use as a booster, but was little used, as the process of manufacture and conditions for use were not satisfactorily perfected by the time the Armistice of November 11, 1918, was declared. Its discovery, therefore, was in no sense a decisive factor in the defeat of Germany.

It will be observed that T.N.A., therefore, was discovered by an English chemist, ten years before the war broke out, was patented in England, the United States and *Germany*, four years before the war began, and, therefore, was well known to German chemists.

On June 5, 1923, I wrote to Dr. Riley, enclosing a copy of Professor Munroe's letter. I concluded my letter as follows:

I call upon you now, formally, hereafter to eliminate the two paragraphs on page 16, for it is an absolutely wrong statement, as you can see by looking up the patents, if you wish to.

For about two years this pamphlet was sold without any alteration of the text. Of late Dr. Riley has added a note on the margin of this paragraph recounting the discovery of T.N.A. by the two young American chemists, as follows: "This illustration, given me by a chemist, is disputed." He is attempting to "save his face" by perversion of the facts. Professor Munroe did not "dispute" this illustration. His letter, above quoted, showed it to be false.

To my limited knowledge the chemical procedure, as described by Dr. Riley, is unintelligible. Professor Munroe wrote that it was "arrant nonsense."

W. W. KEEN

PHILADELPHIA, PA.

THE PROPAGATION OF APPLE VARIETIES BY CUTTINGS

IN the *Journal of Heredity*, September, 1925, attention has been called to the occurrence of burr-knots, which contain root rudiments, on the stems of certain varieties of apple trees, and to the fact that these root rudiments can be readily forced into growth by maintaining damp moss around the stems. It was suggested that probably such material could also be used as detached cuttings in the vegetative propagation of certain varieties of apples. The writer is now able to report that the varieties Buckskin, Springdale, Northern Spy and Buckingham (the only varieties used in the first test) have been propagated by detached cuttings. A commercially satisfactory percentage (above 80 per cent.) of rooted cuttings was obtained. The material used was of pencil size or a little larger and was of the fruit-spur type, being three to five years old. Root rudiments were more or less evident on each cutting at the time it was taken from the tree. The material was cut July 15 from bearing trees in the orchard of the Arlington Experiment Farm, near Washington, D. C. The cuttings were placed in sand in one of the Washington greenhouses, a bench without bottom heat being used. When lifted on August 19, almost every one showed roots from one fourth to four inches in length, although very little callus was observed. There was some evidence to indicate that the presence of functioning leaves was advantageous to root development, as was mentioned by Van Der Lek[1] for willow, poplar and grape cuttings.

From these results it seems that the propagation of apple varieties by hardwood cuttings depends at least in some cases upon the use of material in which root rudiments are already present. It is hoped that physiological studies, now in progress, will throw some light on the question of what are the conditions that bring about the initiation of such root rudiments. The writer will be glad to learn of observations by other workers on the relation of burr-knots and previously formed root rudiments to the rooting of cuttings.

CHARLES F. SWINGLE

BUREAU OF PLANT INDUSTRY,
WASHINGTON, D. C.

THE MACKEREL AND PLANKTONIC ORGANISMS

THE life history of the true mackerels belonging to that great family of Scombridae is full of romance and takes us back to the days of Horace and Pliny. The ancients considered the mackerel a fish of mystery and down to the present time the migratory habits of this great food fish have constituted a problem not easily solved. Lacepede, the French naturalist, in 1798 came to the conclusion that mackerel pass the winter in the Arctic region, where hibernation takes place with their heads buried in the mud.

Badham, writing in 1854, says, "The migrations of mackerel have given rise to wide excursions of the imagination and to much ingenious speculations." The investigations made at Port Erin on planktonic life by Johnstone, Scott, Chadwick and Herdman will prove invaluable in finding the missing link to the life history of the mackerel family.

During the past few years Professor Herdman has

[1] Van Der Lek, H. A. A., "Over de wortelvorming van houtige stekken," Medeelingen van de landbouwhoogeschool te Wageningen (Nederland), Vol. 28, No. 1, 1925.

made an examination of ten thousand samples of plankton relative to growth, reproduction and movements of planktonic organisms. This investigation goes to show that temperature and salinity are a great factor in the rise and fall of planktonic life. Since 1910 the mackerel catches on the Atlantic coast have declined to an alarming extent.

Some of the English scientists have advanced the idea that the mackerel are leaving America and migrating to the European coast. If this is a fact and taking into consideration that mackerel are plankton feeders the solution seems to be centered around the study of planktonic organisms.

The investigation of the seasonal distribution of plankton in the Woods Hole region by Dr. Charles J. Fish, Bureau of Fisheries, will in all probability pave the way towards surveying the Atlantic coast.

No doubt the tagging of mackerel will show appreciable results. But unfortunately many uncontrollable factors enter into the above experiments, such as hyperglycemia due to handling the fish and being exposed to the air, thus causing them to fall easy prey to their enemies after being returned to the water.

RALPH C. JACKSON

U. S. BUREAU OF FISHERIES,
WOODS HOLE, MASS.

ABSTRACTING OLD BOTANICAL WORKS AND MANUSCRIPTS

THE value of a complete abstract journal can not be overestimated; we all recognize the great importance of periodicals, such as *Botanical Abstracts, Botanisches Centralblatt, Chemical Abstracts* and a number of similar papers in other fields of learning.

These publications, however, are of relatively recent origin. For example, Just's *Botanische Jahresbericht* was founded by Just in 1873. *Botanisches Centralblatt* was started in 1880. Previous to this time a wealth of important work had been published: some of it can be found in a number of well-known serials. Some of them are still being published, but the earlier issues are not easily obtainable, except in some of the large institutions of the Old and New World. We need mention only Curtis's *Botanical Magazine* (1786), *Botanische Zeitung* (1843), *Linnaea* (1826), *La Belgique Horticole* (1851), Transactions and Proceedings of the Botanical Society of Edinburgh (1843), Transactions of the Royal Society (1663), *Flore des Serres et des Jardins de l'Europe* (1845) and a number of others.

I have spent considerable time in a number of libraries like those of the British Museum, of Kew Gardens, of the University of Amsterdam, of the University of Berlin and others, studying works on plants and on their economical aspects published in earlier centuries. One is surprised by the fine talent of these observers and workers of times long past, men who were heretofore unknown to us. From the sixteenth until the beginning of the last century men like Malpighi, Grew, Swammerdam, van Leeuwenhoek, Camerarius, Linné, Koelreuter or Sprengel have given us an indelible impression of their achievements, but there are others whose work has been forgotten, and no one can estimate the advantage it will be to science and history to have their work revived. If we consider only the work of an investigator of later date, namely, that of Gregor Mendel, one will realize the importance of this task of abstracting.

There are international catalogues besides those of libraries which will facilitate this work considerably. Also publications like Seguier's "Bibliotheca Botanica," 1740; Wikström's "Litteraturae Botanica in Suecia," 1831; Krüger's "Bibliographia Botanica," 1841, and treatises on the history of botany during certain periods which will contribute very much toward making the task of finding originals easier.

In many libraries there are unknown manuscripts, which are not published and probably never will be published, but which are of enormous value. They may contain views or observations which were not ripe for these days, and therefore were not fully comprehended by the learned world of that time. A systematic search, a perseverance and last but not least a love for one's profession will ensure the completion of this work, which will not only be of great historical value but also to science itself.

J. C. TH. UPHOF

ORLANDO, FLORIDA

SCIENTIFIC BOOKS

Entwicklung und Bibliographie der Pathologisch-Anatomischen Abbildung. By EDGAR GOLDSCHMID. Leipsig, Karl W. Hiersemann, 1925, 301 pp., 44 pl. 4°. Price 150 marks.

THIS is the first serious attempt to grapple with a theme of some moment to medicine, namely, the history of pathology. Pathology, as a generic term, connotes and comprises everything relating to the essential nature of disease. In ordinary usage, however, it denotes the changes in structure and function produced by disease and thus includes both the "anatomical idea" of Virchow and what Allbutt styled "altered physiology," *i.e.*, the facial appearance and physical habitus of different diseases, as well as in paralytic deformities and other derangements of function. The

plates in the present volume cover changes in the external configuration of the face and body (semeiology) as well as pathological changes in structures beneath the skin. It is plain that this phase of the history of pathology is largely the history of its delineation by skilled artists. The author, a Frankfurt professor and prosecutor in the Senckenburg Pathological Institute, has therefore followed the ground-plan of Choulant's famous "History of Anatomical Illustration" (1852). If his adherence to the Choulant tradition seems a bit too formal at whiles, it is to be remembered that his model is one of the greater classics of medicine, a work of infallible accuracy, representing a lifetime of patient research. His book begins with a sketch of the history of pathological illustration, including the technical processes of reproduction. This is followed by a brief bibliography of source-books, after which the author launches bravely into a complete reasoned bibliography of books containing pathological pictures, arranged in five chronological periods. There follow valuable and accurate indices of authors, artists, publishers and books (under authors' names), a subject-index of the diseases and parts of the body illustrated in the different atlases and an index of the forty-four plates, twenty-eight of which are handsomely colored.

The prehistory of the subject comprises accidental figuration of pathological formations on antique vases, stelae, papyri, frescoes, old MSS., primitive pottery, ex voto tablets and the like. Between this phase and the period of conscious or intentional illustration of pathology come the chance figurations on fugitive sheets, in non-medical books, oil paintings, sculpture of the post-antique period and so on. Examples of the early phases, as presented in the plates, are a votive tablet from Athens representing varicose veins, a bit of Huaco sculpture showing facial paralysis, terra-cotta figurations of the facies of disease from Asia Minor, Albert Durer's colored print of syphilis, Ghirlandajo's rhinophyma and a painting of Simon Vouët's, showing suppurative osteomyelitis. The first period of illustration with didactic intention begins with the start made in first-class anatomical illustration by Leonardo da Vinci and Vesalius and goes down to the time of the great surgeon-anatomists of the 18th century (1517-1733). It is the period of wood- and copper-plate engraving and etching, illustrated in the volume by cuts from Bonetus (1686), Valentini (1715) and Heister (1715). The second period, from Cheselden to Soemmering (1733-92), is the period of the surgeon anatomists who produced great atlases in copper and steel-engraving. The third period, from Sandifort to Cruveilhier (1793-1829), marks the rapid victory of colored lithography over colored copper-plates, splendidly exemplified in the pathological reports of Richard Bright (1827-31). The fourth period (1830-60) finds its high spots in the atlases of Cruveilhier (1829-42), Carswell (1838), Lebert (pathological histology, 1845), Danielssen and Boeck on leprosy (1848), Auvert (1851), in the work of the dermatologists and in Virchow's *Archiv* (1847-1925). The fifth period runs from 1860 to the recent developments of chromolithography, photography and the low-priced hand-atlases. The colored plates illustrating these periods are of superlative excellence, particularly those from Cruveilhier, Lebert, Auvert and the dermatological atlases of Alibert (1817-28), Bateman (1830) and Rayer (1839). One misses, it is true, the Venus of Willendorf, the earliest known bit of prehistoric sculpture (showing the endocrine phase of obesity), the achondroplasic dwarf figurines of Egypt, collected by Charcot, the pathological plates of Richard Bright (1827), Corrigan's superb engraving of aortic insufficiency (1832), the facies of Addison's disease (1855) and the wonderful iconography of nervous diseases made under the inspiration and guidance of Charcot. The *Nouvelle Iconographie de la Salpétrière* is, in fact, treated with scant courtesy. Our author does not seem to realize that it consists of twenty-eight stout volumes (1888-1918) containing the most valuable illustrations of the pathology and semeiology of nervous diseases in existence. These pictures show not only the facies and habitus in typical cases, but, in accordance with Charcot's teaching, carefully selected atypical or incipient cases, so that a person with a tendency to acromegaly or exophthalmic goiter might be recognized (say) in a street-car. The excellent *Revue photographique des hôpitaux de Paris* (1869-72) is also omitted. These, however, are slips which it will be easy to correct in a subsequent edition. The book is obviously a *vade mecum* for all medical librarians and will find its way into the collections of professional pathologists who care for their subject. The format is, if anything, too massive and sumptuous. A later edition in smaller size, and with a more definite choice of pictures, would be a valuable acquisition for the active practitioner and surgeon.

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NOTES

THE State Board of Fisheries and Game of Connecticut has just issued "A report of investigations concerning shad in the rivers of Connecticut," by P. N. Mitchell and staff (1925, 63 pages, illustrated) which contains detailed analytical data such as is necessary for intelligent conservation of a given species of fish. Embryology, food, growth, enemies and para-

sites of the shad are discussed, as also the environment. A considerable amount of new information is here contained, and we may mention particularly the contribution to the fascinating science (or art) of reading age and life history from the structure of fish scales, by N. Borodin. It seems that for almost every species of fish this presents a separate problem. In the shad scale, so-called "annuli" are difficult to find, but distinct transverse grooves, running across the annuli, two for each year, are readily made out. Dr. Borodin's results are corroborated in a study of otoliths by R. L. Barney.—J. T. NICHOLS.

A MONOGRAPH, "The Termites of Kartabo, Bartica District, British Guiana" has been lately issued by the department of tropical research of the New York Zoological Society. Dr. Alfred E. Emerson, associate professor of zoology at the University of Pittsburgh and for several years associated with the University Zoological Station at Kartabo, British Guiana, is the author. Seventy-eight species, fifty-one of them discovered by Dr. Emerson, are classified in the volume.—LORENZ G. WALTERS.

IN 1902 the Coast and Geodetic Survey published "Principal Facts of the Earth's Magnetism," by L. A. Bauer, then inspector of magnetic work. This covered the early history of the development of knowledge in regard to the earth's magnetism and gave an appraisal of the knowledge of the subject at the time the publication was issued. A new publication "The Earth's Magnetism," by D. L. Hazard, assistant chief of the division of terrestrial magnetism and seismology, U. S. Coast and Geodetic Survey, replaces the earlier one and it covers not only the early history, but also that of the important period since 1902, during which so much advancement has been made in our knowledge of the subject. It is a fact that this period of intensive world-wide study has made very great progress. At the same time it must be recognized that the final solution of the problems is still very far in the future. The outstanding feature of the first quarter of the twentieth century was the extension by the Department of Terrestrial Magnetism of the Carnegie Institution of Washington of magnetic surveys of all parts of the earth not covered by national governments, and to the high seas. Also the precise work done by many governments, especially that of the United States through the Coast and Geodetic Survey. It appears that in every branch of scientific investigation which must be expected to continue for a long period, appraisal from time to time of the progress that has been made is almost as essential as the actual carrying on of the work.—R. L. FARIS.

SPECIAL ARTICLES

X-RAY DIFFRACTION PATTERNS FROM PLANT MATERIALS

DURING the past three or four years the writer has been making many X-ray diffraction patterns of the materials of plants which are normally thought of as solid substances, such as starch grains, cell-walls, both lignified and non-lignified, and those of hemicelluloses. These materials are very probably built up by additions of layer upon layer at the interface between the substance and the living protoplasm, and for that reason they would be expected to have a certain regularity in their structure. The fact that diffraction patterns are obtained from them is evidence that there is undoubtedly a degree of regularity in the structure, which could only be surmised heretofore. Diffraction lines have been obtained from many plant materials, among which are bast fibers of ramie and hemp; hairs of cotton; tracheids of spruce; starch grains of potato, corn, wheat, cassava and arrow-root; and the sclerenchyma cells from the seeds of *Phytelephas* and of another palm, *Erythea*.

The method used was that devised by Hull[1] for obtaining diffraction lines from powdered crystal materials. It was modified somewhat in order to be more usable with fibers and cells of other kinds. The principles involved include not only those pertaining to the powder method, but on account of the modifications also those which apply to large single crystals.[2]

Although the work is by no means completed, there are several points of a general nature which stand out from the mass of details as items of interest in the study of protoplasmic activities.

In the table only a few of the diffraction lines obtained are given, and they include only the wider interplanar spacings for a few representative substances. More complete studies are given elsewhere,[3] or will appear in the literature at an early date. Since the earlier publications on starch,[3] refinement in the apparatus and a better technique have resulted in the resolution of several lines and in their more accurate measurement. The figures in the table, therefore, will not check exactly with those in the paper to which reference was made. A revision of the earlier work is, of course, necessary, but so far

[1] Hull, A. W., *Phys. Review*, X, 661–696, 1917; and XVII, 571, 1921.

[2] Bragg and Bragg, "X-Rays and Crystal Structure," London, 1924.

[3] Sponsler, O. L., *Amer. Jour. Bot.*, IX, 471, 1922, and *Jour. Gen. Physiol.*, V, 757–776, 1923.

as studied up to the present time it seems doubtful that any great change in the conclusions will be found.

INTERPLANAR SPACINGS

Cellulose	Hemi-cellulose	Starch grains	
Ramie fibers	Phytelephas	Potato	Corn
6.10 A.U.	5.65 A.U.	6.13 A.U.	5.96 A.U.
5.40	4.99	5.23	5.23
5.15	4.48	4.57	4.99
4.35	3.84	4.05	4.40
3.98	3.56	3.73	3.90
3.40	3.33	.....	.....
3.20	.....	.....	.....

The significance of the figures given in the table becomes more evident when we recall the chemical composition of the substances and the way in which diffraction lines are produced. For details of the latter we must refer to the literature already cited. In general, however, we may think of the lines as being produced by "reflection" from planes or layers of atoms, and as the result of reflection from hundreds or thousands of those planes very uniformly spaced. The substances are all carbohydrates of the hexose type. The atoms which produce the reflection, therefore, are those of carbon and oxygen. Hydrogen has a negligible reflecting power, and the amount of other elements which might occur is too small to produce diffraction lines.

In the table it will be noticed that the dimensions of the spacings are comparatively uniform for the different substances. The greatest interplanar spacing is about the same in each; that is, in the neighborhood of 6 A.U. All of them are greater than 3 A. U. Since the diameters of oxygen and carbon atoms are about 1.5 A.U. or less, it seems fairly certain that the units which make up the lattice structure of these materials are composed of *groups of atoms.*

It is not, of course, a safe procedure to predict the size of these structural unit groups until the lattice is carefully worked out, but attention should be directed to what seems to be at least a peculiar coincidence. The volume of a $C_6H_{10}O_5$ group of atoms as it occurs, presumably, in the materials[4] is about equal to the volume of an elementary cell whose dimensions are $6 \times 5.5 \times 5$ A.U. Approximately the same values are present in each column of the table. The C_6 group seems to be the structural unit in starch grains[5] and in plant fibers,[6] and from the data so far presented it would not be surprising if that group kept its identity throughout all these materials.

We may feel fairly certain of this much—that in the plant parts with which we have been working units of structure which approach in size that of a C_6 carbohydrate group occur in a very uniform arrangement; that is, they are not laid down in a haphazard manner. On the contrary, each unit is fitted more or less neatly in place so that a definite lattice structure is formed.

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[4] *Ibid.*

[5] *Ibid.*

[6] The data on plant fibers will soon be submitted for publication.

SUCTION FORCE OF SOILS: A NOTE ON THE APPLICATION OF THIS PRINCIPLE IN THE STUDY OF THE SOIL-PLANT SYSTEM[1]

IT was pointed out[2] how the principle of the suction force of a soil may be utilized for the estimation of the soil colloids. The suction force is measured with the aid of a mercury manometer attached to a porous clay candle which is filled with water and inserted in the soil. The capillary and molecular forces exert a pull on the water producing a negative pressure in the clay candle which is registered on the manometer. The greater the amount of colloids in the soil the greater the suction force. The ratio from the same soil multiplied by 100 gives the percentage of colloids in the soil. The figures in the following table will suffice to illustrate the relationship between the amount of colloids present and the suction force. The various types of the same soil series contain various amounts of clay and apparently the suction force follows the clay content.

Clay	Suction force: rise of mercury column on manometer
Percentage	cm.
4.15	16.9
4.68	16.0
7.11	17.9
19.09	29.05
21.82	39.1

The figures on the clay content are taken from the

[1] Paper No. 248 of the Journal Series, New Jersey Agricultural Experiment Stations, Department of Soil Chemistry and Bacteriology.

[2] Joffe, J. S., and McLean, H. C., 1925, "Colloidal behavior of soils and soil fertility. I. Suction force of soils as an index of the colloid content of soils." To appear soon in *Soil Sci.*, v. 20, 1925.

data on the mechanical analyses of the soils as given by the Soil Survey. It will be noted that the soil with a high clay content will pull up a mercury column close to 40 cm which, in terms of a water column, is equal close to 18 feet. The significance of this will be brought out more clearly when we shall presently speak of certain irrigation projects based on the suction force.

Several other applications of the suction force principle may be suggested.

It is known that the roots of the plant imbibe water from the soil with a certain force. Briggs and McCall[3] have produced an artificial root with which they attempted to measure this force. What they actually did was to measure in part the suction force of the soil. Now it is reasonable to assume that since the suction force, as described by the authors, is a property of the surface energy of the substances in immediate contact with the outside wall of the porous candle, then the force exhibited by the soil is the force which plant roots have to overcome when the soil ceases to be saturated. At saturation no force has to be exhibited by the plant roots save that of absorbing the water against gravity. As we decrease the moisture content of the soil the greater the force the plant roots have to exert in order to pull the water. The suction force of the soil as shown by Kornev[4] reaches its critical moment when it is equal to about one half of its saturation. It then drops. This phenomenon may easily be linked together with the wilting point of plants in plant physiological researches. It will be possible to determine the wilting point in terms of the suction force. In clay soils with a relatively high moisture content, wilting appears earlier than in sandy soils with less moisture. The clay exhibits a tremendous suction force which the plant has to overcome, while in sand there is practically no suction force to oppose the pulling power of the plant. The suction force principle may therefore be applied in quantitative studies of wilting coefficients in the soil-plant system. Various soils will differ in their suction force and it is this force which undoubtedly determines the critical point of moisture content in relation to wilting. But there is another aspect of this relation. Caldwell[5] states, and this is borne out by Shive and Livingston,[6] that "under any given set of conditions, the observed soil moisture content at permanent wilting is approximately a constant for each of the soils used, and its value increases with the increase in rate of transpiration, being greater under conditions of high evaporation intensity and declining with decrease in the evaporating power of the air." In the light of the phenomenon of the suction force of soils, the above may be looked upon as follows: when the suction force of the soil is greater than the pulling power of the plant wilting must ensue. The factor or factors which influence the pulling power of the plant, such as high or low evaporation intensity, will shift the equilibrium between the suction force of the soil and the pulling power of the plant. The problem of the wilting of plants may thus be reduced to a study of the two factors: the suction force of the soil and the evaporation intensity of the air as it is linked with transpiration. The advantage of using the suction force expression lies in the fact that it is an inherent property of the physico-chemical make-up of the soil.

Another possible application of the suction force of the soil is a study of the moisture movement in the soil profiles. As mentioned above the suction force of a soil is chiefly governed by the surface effects of the colloid fraction of the soil. It is natural that the movement of the water between the adjacent layers of soil should be controlled by this suction force. A study of the suction force of the various layers of the plowed or tillable soil horizon may reveal some interesting data in respect of the vantage points in the soil in respect to moisture relationships.

When, for the sake of argument, the upper layer of the soil has a suction force of 25 cm and the zero point (no suction force) is at 30 per cent. moisture content, the next adjacent layer has a suction force of 30 cm and its zero point is at 35 per cent. moisture, we may expect a resultant forcing the water downward. There may be conditions whereby the movement of water will be upward. All that will have its influence on the power of plants to imbibe water, and the entire picture of the suction force of the various horizons will give us information on the movement of soil water.

One of the primary objects of the study of the suction force by Kornev[7] was for the purpose of

[3] Briggs, L. J., and McCall, A. G., 1904, "An artificial root for inducing capillary movement of soil moisture." In SCIENCE, N. S. 20, No. 13, pp. 566–569.

[4] Kornev, V. G., 1924, "The suction force of soils," In *Zhurnal Opitnoi. Agron.* (*Russian Jour. of Exp. Agron.*) 22 (Orig. papers) pp. 105–111, (1921–1923).

[5] Caldwell, Joseph Stewart, 1913, "The relation of environmental conditions to the phenomenon of permanent wilting in plants." In *Phys. Resear.* v. 1, no. 1, pp. 1–56.

[6] Shive, John W., and Livingston, Burton E., 1914, "The relation of atmospheric evaporating power to soil moisture content at permanent wilting in plants." In *Plant World*, v. 17, no. 4, pp. 81–121.

[7] Kornev, V. G., 1924, "The absorbing power of soils and the principle of automatic self-irrigation of soils." In *Soil Sci.*, v. 17, pp. 428–429.